top problems of the Internet and how you can help

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the significant problems we face cannot be solved by the same level of thinking that created them.
--Albert Einstein

16 problems of the net

- scalable configuration management (complexity, layering, legacy)
- security (aka 15 other things)
- host patching (aka ‘running bad software on purpose’)
- knowing what's on your network (measurement)
- spam
- authentication
- interdomain qos (aka ‘911’)
- compromise of e2e principle (aka ‘meeting market demand’)
- dumb network
- robust scalability of routing system
- “normal accidents” (charles perrow, we need him to study Internet)
- intellectual property and digital rights (aka ‘comatose industries’)
- governance (aka ‘regulation’)
- growth in traffic and user expectation
- inter-provider vendor/business coordination
- time management and prioritization of tasks

e.g.,Internet measurement: state-of-art

- can't measure topology effectively in either direction, at any layer
- can't track propagation of a BGP update across the Internet.
- can't get router to give you its whole RIB, just FIB (best routes)
- can't get precise one-way delay from two places on the Internet
- can't get an hour of packets from the core
- can't get accurate flow counts from the core
- can't get anything from the core with real addresses in it
- can't get topology of core
- can't get accurate bandwidth or capacity info
  - not even along a path, much less per link
- SNMP just an albatross (enough to inspire telco envy)
- no 'why' tool: what's causing problem now?
- privacy/legal issues deter research
- how to build this missing theory? -- discouraging to academics

Result: measurements are a meager shadow of careening ecosystem.

[If you are not scared i am not explaining this right.]

The modern field of elementary particle physics depended crucially on the establishment of a huge volume of data gathered mainly in the period 1945-65. Only then was it possible for the synthesis of the Standard Model to take place, 1967-74.

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why so persistently unsolvable?

- 1) rooted in non-technical issues: economics, ownership, and trust
- 2) not amenable to purely technical solutions -- require interdisciplinary investment
- 3) not amenable to < 4-year solutions (so even academia is out)
- 4) noone owns the problems

who can we get to help?

- ietf: lacks operational experience
- academia: lacks access to the infrastructure
  - no funding structure to incent attention to 20-year problems
- engineers (nanog): lacks (financial or legal) incentive structure to support cooperative work
- industry: lacks incentive
- content distribution companies: busy trying to suffocate technology
- govt: lacks clue re 21st century technology

what are we trying to do here?

The problem faced by the Internet industry is in ensuring that each provider of infrastructure is fairly compensated when its infrastructure is used. In essence, the problem is how to distribute the revenue gained from the retail sale of Internet access and services to the providers of carriage infrastructure. ....

While it is not completely clear that the deregulated open market nature of the Internet can sustain a diverse, efficient and effective service provider industry, it is also unclear what form of regulatory constraints or intervention are appropriate, if any.
.... There is a strong risk that regulatory involvement, if applied inappropriately, will trigger structural inefficiencies that ultimately will be reflected at the consumer level in higher prices and inferior services. Competition is not an end in itself, nor is regulatory impost. The challenge here is to foster the conditions that allow the Internet to be a productive and efficient platform for all. That, for me, appears to be at the heart of the challenge of the Information Society. Geoff Huston January 2005

public vs private provision

- we don't really have a good grasp of the economics, social, or cultural impact, so aren't in a position to really say yet how the commodity of digital information transport should be best delivered to society
- tremendous struggles for next few decades as we learn the economics the hard way (amidst multiple sources of measurement error)

forward-looking reading

- eben moglen, columbia
  - *freedom of thought*
- lawrence lessig, harvard
  - *code is law, future of ideas*
- yochai benkler, yale
  - *linux and the nature of the firm*

constituency responses to situation

- federally funded research community: battles clock
- nsf: battles incrementalism
- operational community: battles worms & growth w/ minimal cooperation
- telecom: battles antique regulation, unprofitability/mergers, we-the-people
- copyright-owners: battles its own customers with state backing
- fcc: battles irrelevancy (and wardrobe malfunctions, howard stern)
- military: battlefield ISP (profoundly important)
- people who can afford it: build their own (google, aol, cenic)
- rest of world: battles digital divide
- UN/ITU: grasps for power

implications for empirical Internet research

- need to start asking questions we ask of critical infrastructure
- need vehicles to inform policy
- need vehicles to protect & analyze data

implications for architectural Internet research

- goal: design `in the light' (first time ever..)
- need interdisciplinary, multi-agency investment
- need longer-term thinking than any current vehicle supports, e.g., need to anticipate not just technical but social and political trends 25 years out
- non-hierarchical frameworks merit attention

implications for intellectual property

- assumption: in 25 years, everyone has unmediated connectivity to everyone else
- stronger copyright protection for cyberspace: “desirable, inevitable, and irrelevant.” (andrew odlyzko said 9 years ago)
- cost of distribution -> 0. companies who charge for free services will go away

implications for regulatory research

- goal: bring regulation and economic models in congruity with technology and empirical data
- investigate alternative models of provisioning
- CENIC can play a role here
- so can estonia
  - http://www.privacyinternational.org/survey/phr2003/countries/estonia.htm "The 1992 Estonia Constitution recognizes the right of privacy, secrecy of communications, and data protection."

implications for CENIC

- hopefully you'll be inspired to help
- push your fiscal and other lessons outside the CENIC community into your communities, to the state, to the world
- enlightened connectivity models will serve 'fittest' societies in the 21st centuries
- north star: most economic way to promote freedom of access to all
- promote open analyses of cost models: how much is unfettered p2p digital access worth?

should california have a cenic?

- a la stem cell initiative
- or proposition 215 for spectrum in california
- e.g., just start using it. ignore federal stance.
- demonstrate open spectrum has higher social value than cost
- emphasize that provisioning models can change as technologies and goals change

questions & feedback?

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